

## **RESTORATION OF UPLAND FORESTS TO LONGLEAF PINE: Does it Influence Fuel Load, Restore Native Forest Cover, and Reduce Fire Danger**

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**ABSTRACT:** In the southern United States, the chief influence of burning on landscapes is not how fire influences long-term pine yield but rather how fire influences overall stand structure and species composition. Without the continual use of fire, a forest canopy will develop with a basal area dominated by loblolly pine overstory trees. Beneath this canopy, a well developed midstory and understory of woody plants and vines with draped and ladder fuels will evolve. The resulting deep shade and accumulation of litter will nearly eliminate herbaceous vegetation.

We have become convinced that on most upland sites a series of preharvest treatments are needed to ensure the restoration of longleaf pine plant communities and lessen the hazard of wildfires on these pyric landscapes.

Our objective in this Joint Fire Science Program project is demonstrate changes in fuel load condition on uplands being restored to longleaf pine in the West Gulf Coastal Plain. First, we are evaluating two conversion treatments: (1) clearcutting and (2) harvesting to a longleaf pine shelterwood. These treatments are being compared to (3) unharvested forest. Treatments 1 and 2 are planted with longleaf pine seedlings. Second, each of the three treatments is subdivided for evaluating vegetation management practices: (a) untreated condition, (b) prescribed burning only, and (c) a combination of mechanical woody plant control and prescribed burning. Over time, this will allow us to evaluate how different combinations of treatments influence the management and development of forest fuels, vegetation, and structure on sites being restored to longleaf pine.

## **INTRODUCTION**

In the southeastern United States, wildland fuels accumulate, and without fire management, understory vegetation can shift from grasses to woody plants with significant numbers of highly flammable shrubs supporting draped fuels (Haywood and Grelen 2000, Haywood et al. 2001). We believe this shift in vegetation increases fire intensity, which makes fire fighting more hazardous and costly and places property and natural resources in greater danger. To avoid this outcome, many forest managers are trying to increase the use of fire in upland forest landscapes and to ultimately restore existing upland loblolly pine-hardwood forests to the native fire-manageable longleaf pine ecosystem. The desired future condition being pure longleaf overstories (80% or more of the basal area is longleaf pine), with few if any midstory hardwoods except in riparian areas, and a rich, diverse ground cover of herbaceous and low woody plants.

As part of this effort, our Joint Fire Science Program project evaluates changing fuel conditions as upland loblolly pine-hardwood forests are restored to longleaf pine in the West Gulf Coastal Plain. At each demonstration site we are comparing two vegetation management treatments—prescribed burning alone or in combination with mechanical woody plant control—to an untreated check.

## **DEMONSTRATION AREAS**

The demonstration areas lie within the humid, temperate, coastal plain and flatwoods province of the West Gulf region of the southeastern United States and are suitable for the restoration of loamy dry-mesic upland longleaf pine forests (Turner et al. 1999). They are located within the boundaries of the Kisatchie National Forest in central Louisiana at an average elevation of 100 to 200 ft above sea level. Slopes vary from 1 to 10%.

The original longleaf pine forests were cutover beginning in the 1920s. Although some small stands of pine remained, a general cover of perennial grasses under scattered pines and hardwoods was maintained by periodic burning for open-range grazing. Hogs were excluded in the 1950s and cattle stocking was regulated. Eventually, natural and plantation stands of pines and hardwoods reforested much of the

landscape; in which we established three demonstration areas that represent stages in the change from loblolly pine to longleaf pine forest—loblolly pine, mixed pine, and seedling and sapling longleaf pine plantation.

### STUDY DESIGN

Each demonstration area is a block. Each block is about 20 acres and was divided into three parts to which three treatments were randomly assigned: (1) **check**: no treatment; (2) **prescribed burning only**: plots are prescribed burned every two years beginning in May 2001; and (3) **mechanical woody plant control and prescribed burning**: plots were prescribed burned as in treatment 2, and in July 2002, the understory vegetation was cut to within 2 inches of the ground with a machine-mounted horizontal-shaft drum shredder (Woodgator®).

### PLOT LAYOUT AND MEASUREMENT

A 0.25-acre main plot was established within each check and treated area. In April 2001, woody plants greater than 4-inch dbh were measured and inventoried by species. To measure and inventory trees and shrubs 1 to 4 inches in dbh, four 12-by-12 ft plots were randomly selected and permanently established within each main plot. The overstory and midstory vegetation was again examined in July 2001 after the burns. Understory trees and shrubs < 1-inch dbh, blackberry, woody vines, and herbage were inventoried and percent cover ocularly estimated in July 2001 on a 3.3-by-3.3 ft subplot that was nested within each 12-by-12 ft plot.

To determine changes in available fuels, four 6.6-by-16.5 ft fuel plots were randomly selected and permanently established within each main plot. Each fuel plot was divided into ten 3.3-by-3.3 ft subplots for sampling without replacement. Fuel samples were collected on one subplot per fuel plot a month before the May-2001 prescribed burns. A second subplot was sampled 6 weeks after the burns. Fuel samples were divided into three classes that were considered available for combustion before being oven-dried and weighed: (1) living foliage within 6 ft of the ground; (2) living blackberry canes, woody stems, and vines no more than 0.25 inch in diameter; (3) 1-hour time-lag dead fuels (surface litter and duff to a 0.25 inch depth and small roundwood, and stubble no more than 0.25 inch in diameter).

### RESULTS AND DISCUSSION

The overstory and midstory vegetation was not affected by prescribed burning. Due to dry soil conditions in May 2001, a burning root breached the fireline on the loblolly pine site and the check plot was accidentally burned. Nevertheless after the burn, understory trees, shrubs, and woody vines still shaded 41% of the ground (Table 1). In the mixed pine stand, burning reduced understory tree, shrub, blackberry, and vine cover by 74 percentage points, but the coverage of forbs and ferns increased after burning. The responses to burning in the mixed pine stand were the normally expected short-term outcome. In the seedling and sapling longleaf pine plantation, grasses dominated the understory vegetation, and burning had little effect on the relative importance of the plant taxa. Burning reduced overall ground cover from 97 to 85% in the longleaf plantation.

Table 1—Percent cover of the understory vegetation by taxa on the burned and unburned portions of each forest stand 6 weeks after the May-2001 burns

Plant taxa	Loblolly pine		Mixed pine		Seedling and sapling longleaf pine plantation	
	No burn	Burn	No burn	Burn	No burn	Burn
Trees and shrubs < 1-inch dbh	---	27	87	25	16	17
Blackberry	---	1	3			1
Woody vines	---	14	14	4	4	3
Grasses	---	3	7	8	59	50
Grass-like plants	---	<1	<1		<1	1
Forbs	---	4	2	9	9	7
Legumes	---	1	3	2	4	3
Ferns	---	0	<1	4	4	3

\*No data.

Table 2—Fuels available for burning (lb/acre oven-dried weight) by fuel classes and three forest types before and 6 weeks after the May-2001 burns

Fuel classes	Loblolly pine		Mixed pine		Seedling and sapling longleaf pine plantation	
	before	after	before	after	before	after
Live foliage	489	55	760	31	1,096	406
Live stems ≤ 0.25 inch diameter	876	45	658	4	268	13
Post burn re-growth	0	226	0	164	0	792
Post burn needle cast	0	96	0	1,428	0	12
1-hr time-lag dead fuels	7,643	4,709	9,102	1,869	3,745	1,196

Fire greatly affected the living available fuels, oven-dried lb/acre of foliage was reduced by 89, 96, and 63% and oven-dried lb/acre of stems was reduced by 95, 99, and 95%, respectively, in the loblolly pine, mixed pine, and young longleaf pine stands (Table 2). The average pre-burn weight of these two fuel classes was similar on all three sites and averaged 1,382 lb/acre. However, post-burn re-growth occurred and replaced 17, 12, and 58% of the pre-burn living fuels on the three sites, respectively, in 6 weeks. Needle-cast resulting from the burns occurred on all sites, but was most significant on the mixed pine site. The weight of 1-hr time-lag fuels was reduced by 62% across all three sites. Overall, burning reduced total available fuel load from an average of 8,212 lb/acre to 3,682 lb/acre or by 55% across all three sites.

We concluded that a single burn did not greatly change overall fuel conditions or the composition of the understory vegetation, but single burns rarely do (Haywood and Grelen 2000, and Haywood et al. 2001). We expect that additional burning with and without mechanical woody plant control will have significant effects in the future without greatly altering the overstory vegetation. Changing the composition of the overstory vegetation should require additional treatments, such as thinning or a shelterwood regeneration

cut. Our long-term goal is to study the effects of these kinds of stand management and regeneration techniques on fuel loads as well.

## **ACKNOWLEDGEMENT**

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